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THE LIKELIHOOD OF SPILLS REACHING LONG ISLAND FROM HYPOTHETICAL OFFSHORE FINDS OVER THE DEVELOPMENT'S LIFE

by

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1. RESULTS FOR INDIVIDUAL LANDING PROBABILITY CONTOURS

In an earlier study, Stewart (1974) estimated the probability that an individual spill on the continental shelf off of Long Island would reach Long Island as a function of location of the spill and season. The results of this study were contours of equal probability of individual spills landing such as those shown in Figures 1 and 2.

Still earlier, Devanney et al. (1974), using Bayesian techniques and historical spill data, estimated the probability density of the number of spills over a thousand barrels which will occur over the life of hypothetical 125 million barrel, 500 million barrel, and two billion barrel recoverable finds. These estimates were made for platform spills, for pipeline spills assuming the find is brought ashore by pipeline, and for tanker spills assuming the find is brought ashore by tanker. The results of this study are summarized in Figures 3 through 11. Note that the probabilities apply only to sizable spills (over a thousand barrels). An actual find would involve hundreds to thousands of smaller spills. In general, these smaller spills will be identifiable as slicks for at most a day or two and hence, with typical times to shore of ten days or more for spills which occur twenty miles or more offshore, have been ignored in this paper.

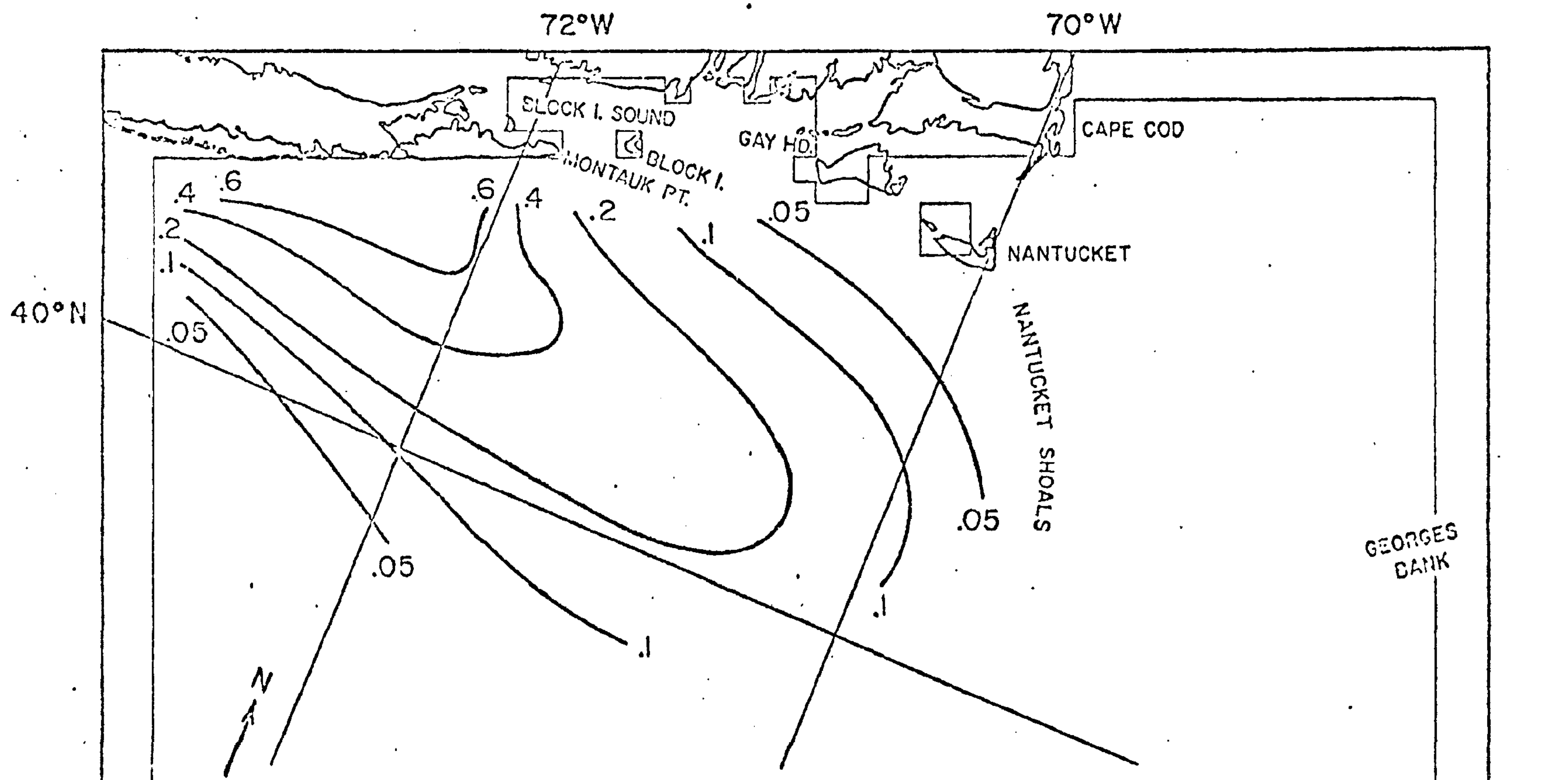

FIGURE 1 CONTOURS OF PROBABILITY THAT A SPILL RELEASED IN THE OFFSHORE REGION DURING SUMMER WILL IMPACT LONG ISLAND FOR THE 10 MILE SEA BREEZE ASSUMPTION.

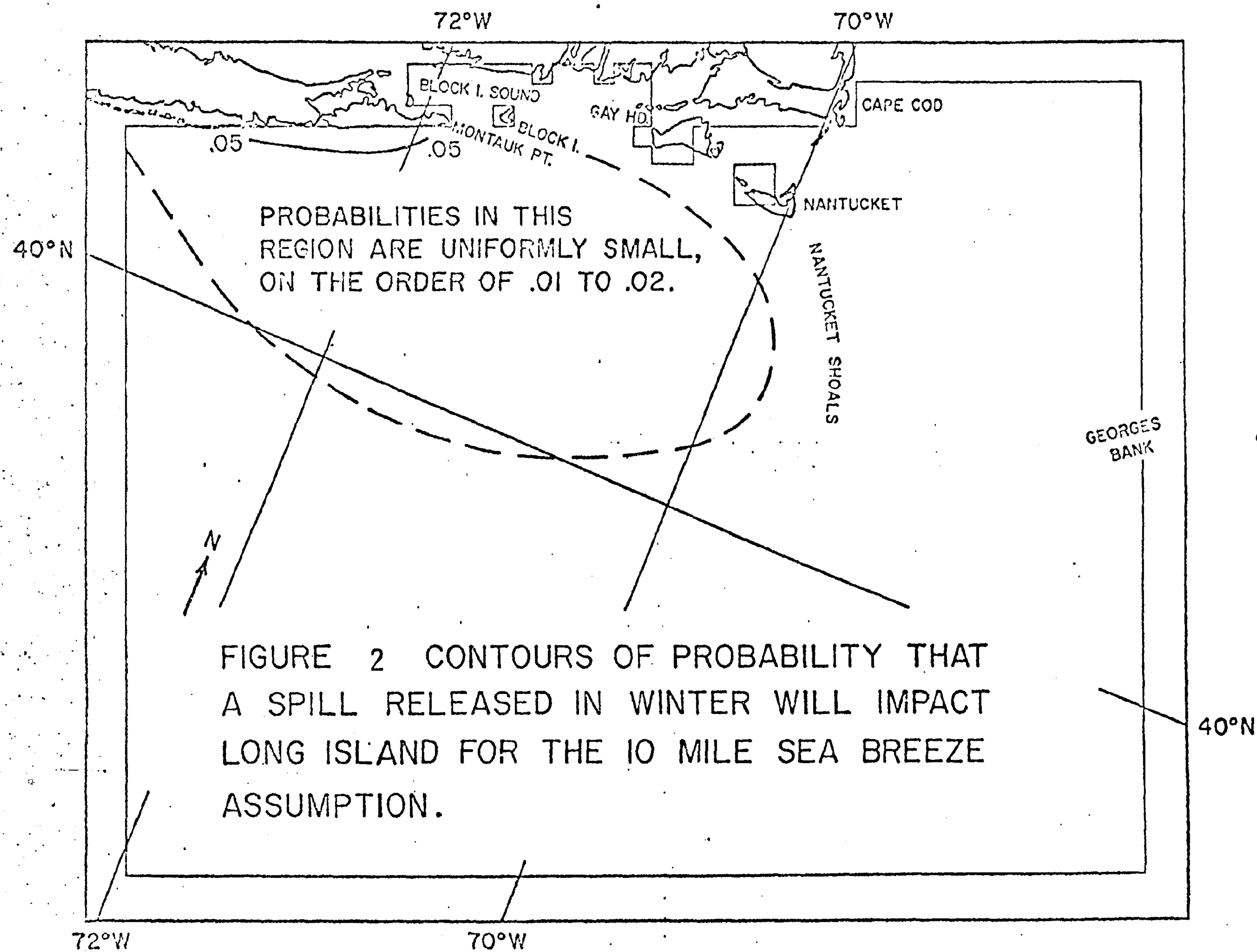

FIGURE 2 CONTOURS OF PROBABILITY THAT A SPILL RELEASED IN WINTER WILL IMPACT LONG ISLAND FOR THE 10 MILE SEA BREEZE ASSUMPTION.

Once one has for a particular spill location and season the probability that an individual spill occurring at this location will reach shore, s, and one has the probability of n such spills occurring over the life of a specified find, p(n), for all possible n from 0 on up, then an obvious question to ask is: what is the probability, A, that at least one spill reaches shore from a find of specified size at a specified location over this development's life? If one is willing to assume that spill occurrences are independent, then the probability of at least one spill reaching shore, A, given p(n) and s

$$A = \sum_{n=0}^{N} p(n)(1 - (1 - s)^{n})$$

where N is large enough so that the probability of more than N spills is small enough to be neglected.

MIT has constructed a little program which combines a given spill incidence density, p(n), and a given s according to the above expression. It is clear that for a given p(n), A will be the same along any contour of equal s in Figures 1 and 2. The program computes A for the following seven contours: s = .01, s = .02, s = .05, s = .10, s = .20, s = .40, s = .60. Therefore, in interpreting the results, it will be necessary to continually refer back to Figures 1 and 2 to see what hypothetical spill locations correspond to the s being analyzed. We have exercised this program on the nine different spill incidence densities shown in Figures 3 through 11. The results are tabulated in Table 1.

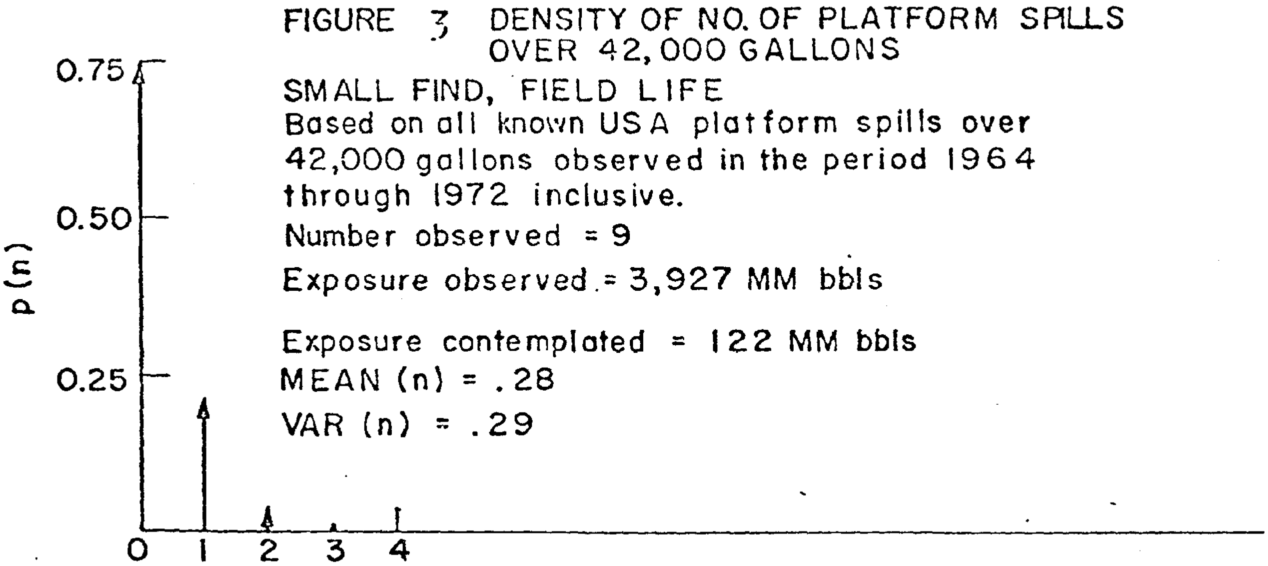

FIGURE 3 DENSITY OF NO. OF PLATFORM SPILLS OVER 42,000 GALLONS

SMALL FIND, FIELD LIFE

Based on all known USA platform spills over 42,000 gallons observed in the period 1964 through 1972 inclusive.

Number observed = 9

Exposure observed = 3,927 MM bbls

Exposure contemplated = 122 MM bbls

MEAN (n) = .28

VAR (n) = .29

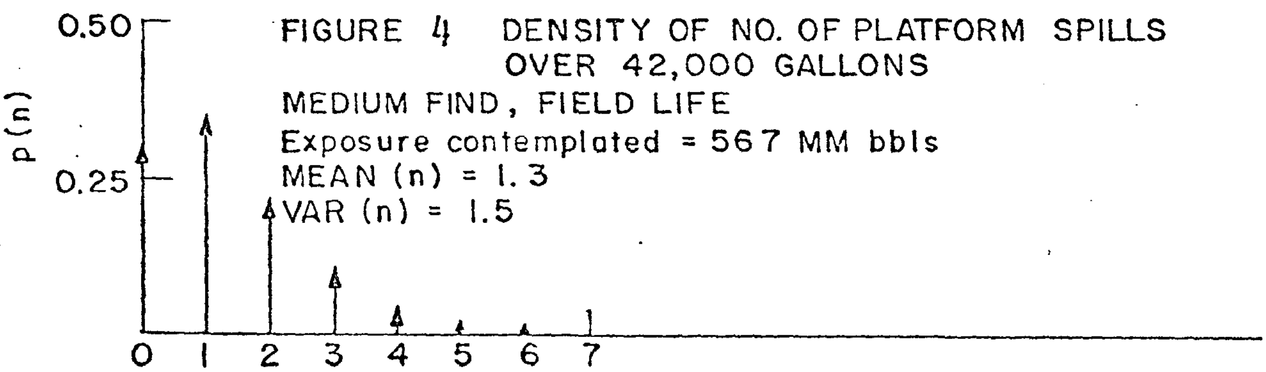

FIGURE 4 DENSITY OF NO. OF PLATFORM SPILLS OVER 42,000 GALLONS

MEDIUM FIND, FIELD LIFE

Exposure contemplated = 567 MM bbls

MEAN (n) = 1.3

VAR (n) = 1.5

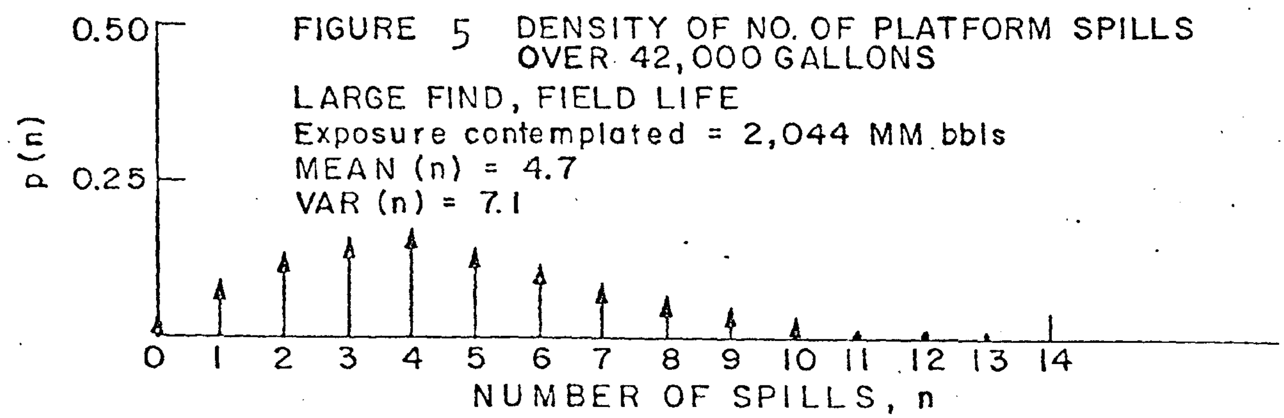

FIGURE 5 DENSITY OF NO. OF PLATFORM SPILLS OVER 42,000 GALLONS

LARGE FIND, FIELD LIFE

Exposure contemplated = 2,044 MM bbls

MEAN (n) = 4.7

VAR (n) = 7.1

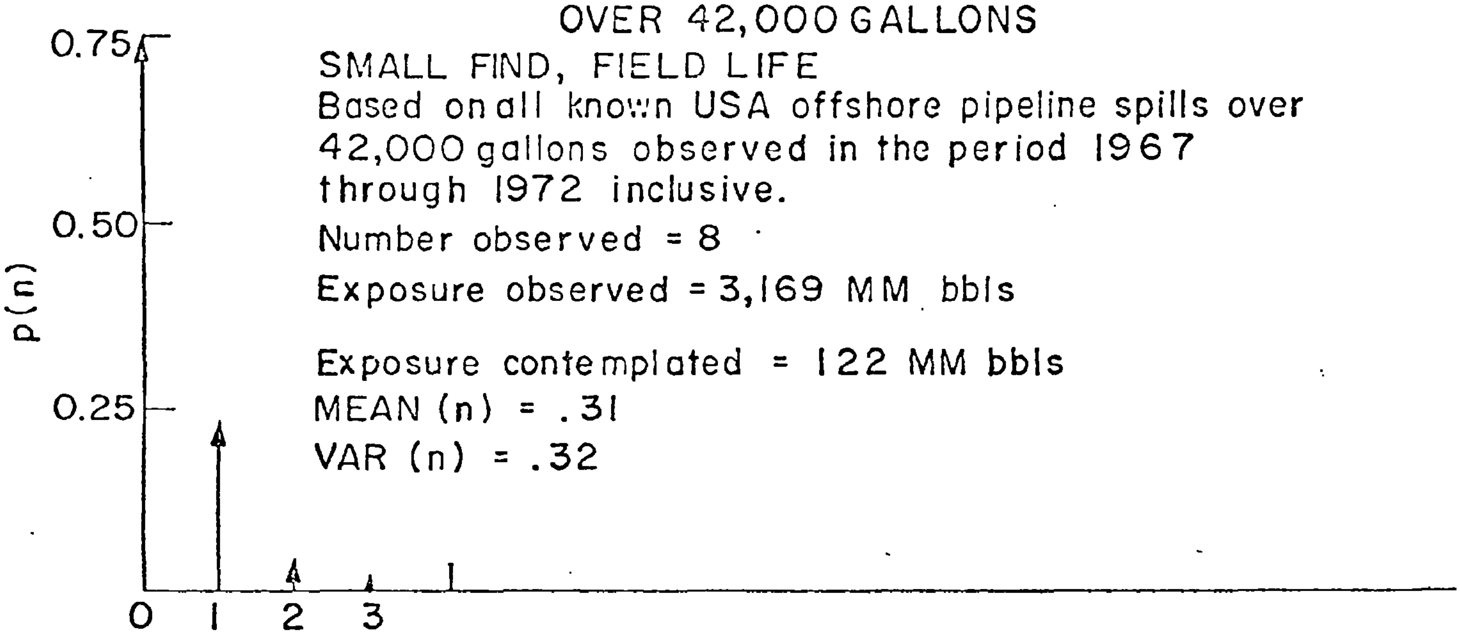

FIGURE 6 DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

SMALL FIND, FIELD LIFE

Based on all known USA offshore pipeline spills over 42,000 gallons observed in the period 1967 through 1972 inclusive.

Number observed = 8

Exposure observed = 3,169 MM bbls

Exposure contemplated = 122 MM bbls

MEAN (n) = .31

VAR (n) = .32

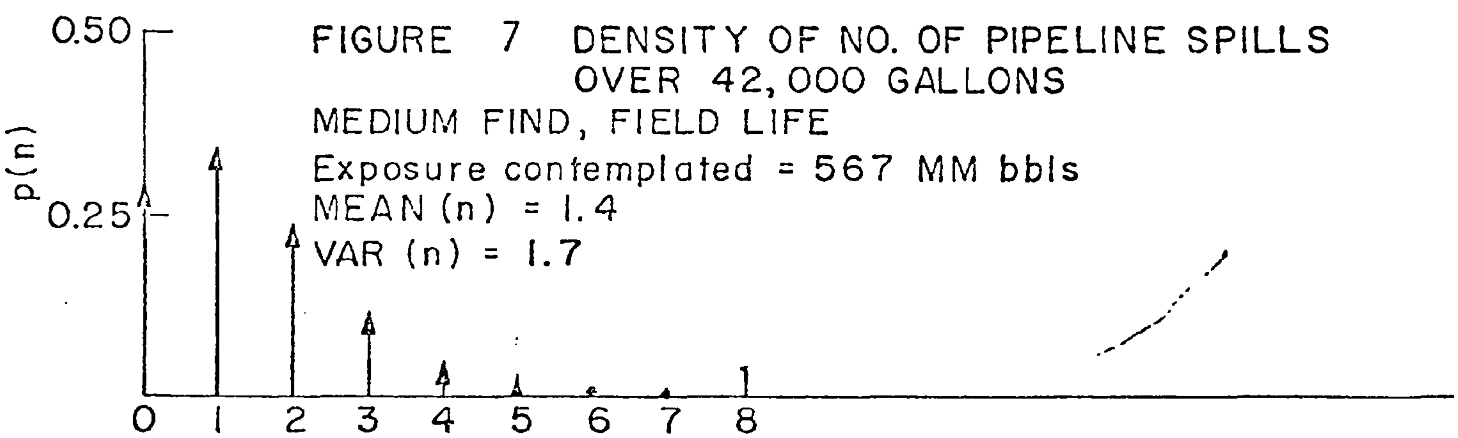

FIGURE 7 DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

MEDIUM FIND, FIELD LIFE

Exposure contemplated = 567 MM bbls

MEAN (n) = 1.4

VAR (n) = 1.7

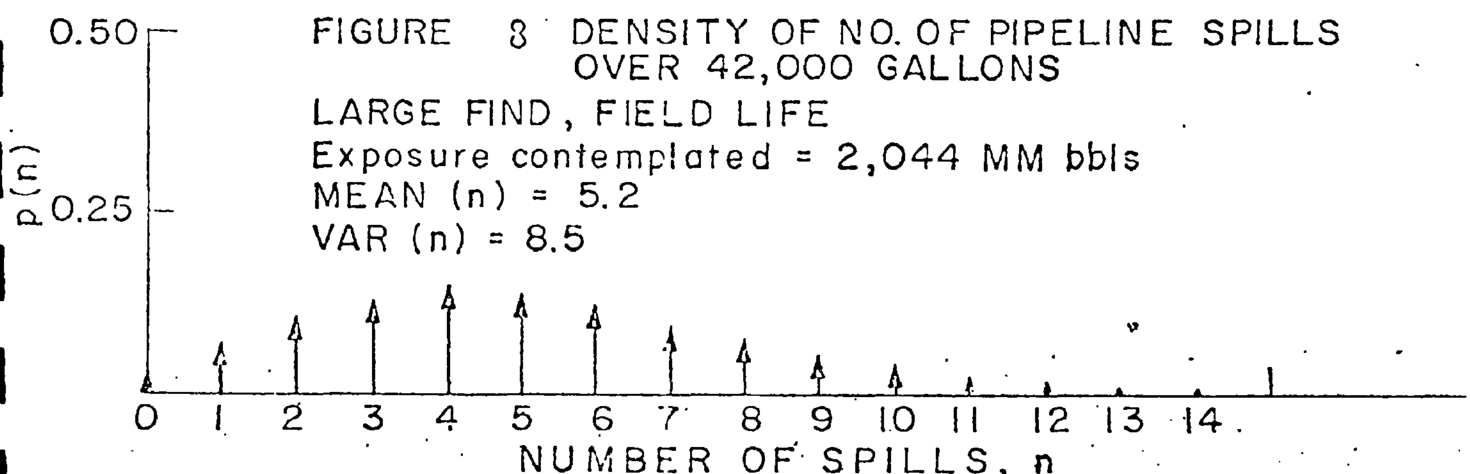

FIGURE 8 DENSITY OF NO. OF PIPELINE SPILLS OVER 42,000 GALLONS

LARGE FIND, FIELD LIFE

Exposure contemplated = 2,044 MM bbls

MEAN (n) = 5.2

VAR (n) = 8.5

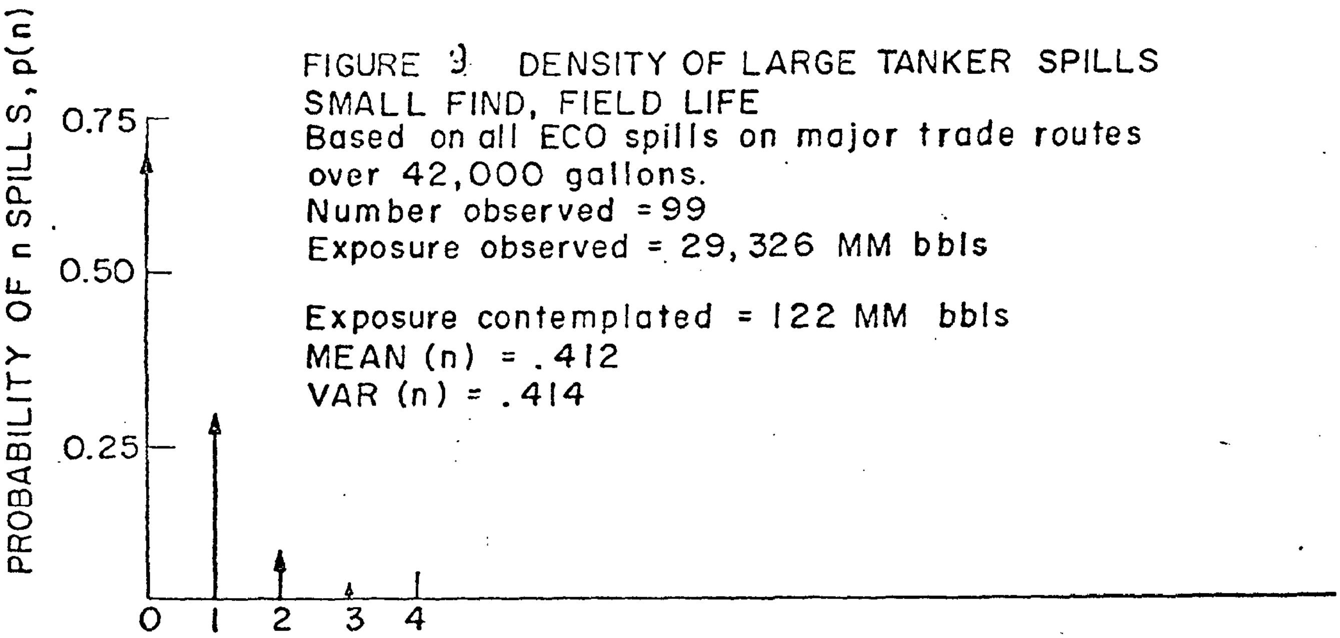

FIGURE 9 DENSITY OF LARGE TANKER SPILLS
SMALL FIND, FIELD LIFE
Based on all ECO spills on major trade routes over 42,000 gallons.
Number observed = 99
Exposure observed = 29,326 MM bbls

Exposure contemplated = 122 MM bbls
MEAN (n) = .412
VAR (n) = .414

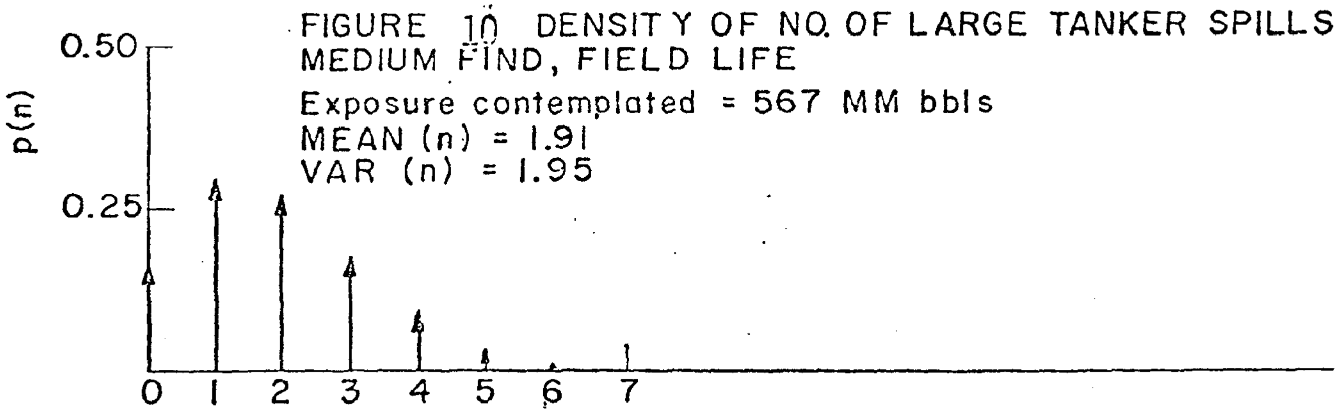

FIGURE 10 DENSITY OF NO. OF LARGE TANKER SPILLS
MEDIUM FIND, FIELD LIFE
Exposure contemplated = 567 MM bbls
MEAN (n) = 1.91
VAR (n) = 1.95

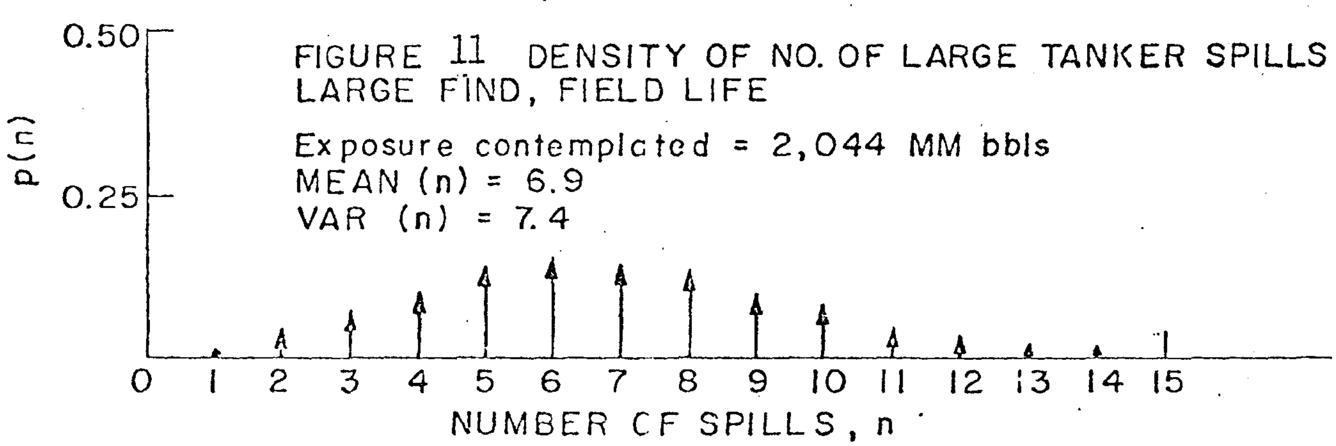

FIGURE 11 DENSITY OF NO. OF LARGE TANKER SPILLS
LARGE FIND, FIELD LIFE
Exposure contemplated = 2,044 MM bbls
MEAN (n) = 6.9
VAR (n) = 7.4

TABLE 1

PROBABILITY BY TYPE OF AT LEAST ONE SPILL OVER 1000 BARRELS REACHING LONG ISLAND OVER THE LIFE OF FIND--FUNCTION OF LOCATIONAL CONTOUR, FIND SIZE, AND SPILL TYPE

		Contour on which Find is Located						
		.01	.02	.05	.10	.20	.40	.60
100 MM bbl Produced	Platform	.003	.006	.014	.027	.054	.105	.153
	Pipeline	.003	.006	.015	.030	.060	.115	.167
	Tanker	.006	.013	.031	.062	.120	.226	.318
250 MM bbl Produced	Platform	.013	.026	.063	.121	.226	.397	.526
	Pipeline	.014	.028	.069	.132	.245	.425	.557
	Tanker	.014	.028	.069	.133	.248	.434	.575
2000 MM bbl Produced	Platform	.046	.089	.206	.366	.589	.817	.913
	Pipeline	.050	.097	.224	.393	.621	.840	.926
	Tanker	.066	.128	.291	.497	.745	.934	.982

The numbers range from .002 for platform spills from a 125 million barrel find on a .01 contour to .982 for tanker spills from a two billion barrel recoverable find located on a .6 contour. In short, the probability of at least one spill reaching shore over the life of a find depends critically on the find's location and size. Not surprisingly, a very large find within the .2 contour has a high probability of at least one spill reaching shore, while the 125 million barrel find has a good chance of not landing a large spill even if it is located rather close to shore.

Since any hypothetical find will involve either platform(s) <u>and</u> pipeline(s) or platform(s) <u>and</u> tankers, if we assume that the occurrences of spills of different types are independent we can transform Table 1 into Table 2, which displays the probabilities of at least one spill <u>of any type</u> reaching shore over the find's life as a function of find size and location. In interpreting these figures, several things should be kept in mind:

1. The spill incidence densities are based on the twin hypotheses that the mean spill incidence rate is proportional to volume of oil produced and that we don't do any better with respect to preventing large spills in the future than we have done over the last ten years. Both these assumptions may be overly pessimistic. For platforms and pipelines all spill data is based

TABLE 2

PROBABILITY OF AT LEAST ONE SPILL OF ANY TYPE REACHING LONG ISLAND OVER THE OVER THE LIFE OF A FIND AS A FUNCTION OF LOCATIONAL CONTOUR, FIND SIZE, AND SPILL TYPE

		Contour on which Find is Located						
		.01	.02	.05	.10	.20	.40	.60
100 MM bbl Landed	Landed by Pipeline	.005	.010	.027	.052	.102	.192	.269
	Landed by Tanker	.009	.019	.043	.084	.158	.295	.401
250 MM bbl Landed	Landed by Pipeline	.027	.054	.132	.237	.415	.653	.790
	Landed by Tanker	.027	.054	.132	.238	.417	.660	.799
2000 MM bbl Landed	Landed by Pipeline	.096	.188	.383	.615	.844	.971	.994
	Landed by Tanker	.112	.217	.437	.681	.895	.988	.998

on Gulf of Mexico experience, where small fields by offshore standards, use of now obsolescent technology, and probably unnecessarily low well production limitations combine to produce a considerably higher ratio of wells to production and platforms to production than we would expect to use on the Atlantic outer continental shelf (OCS). Thus, if number of wells or number of platforms is a better measure of activity from the point of view of spill incidence than volume handled, then at least our platform spill incidence densities are overly pessimistic. Obviously, any improvements in operating procedures or technology which reduce spill likelihoods from what they have been in the recent past will also make our estimates overly pessimistic.

2. As Figures 1 and 2 indicate, the potential drilling areas on the Georges Bank identified by CEQ fall outside the .05 contour. Thus, with respect to spills originating on the Georges Bank, the three leftmost columns of Tables 1 and 2 are of most direct relevence. As Figure 1 indicates, the .6 contour applies only to spills released within twenty-five miles of Long Island during the summer and much less than that during the winter.

3. Stewart (1974) estimated the minimum time to Long Island of spills occurring on Nantucket Shoals and eastward was twenty days or more. All but very large spills of medium to heavy crudes are likely to be invisible to the naked eye after twenty days at sea due to weathering. Neither Table 1 nor Table 2 accounts for weathering and the effect that weathering will have in reducing the impact of the spill if and when it does reach shore.

4. Not all spills need occur at the location of the find. A pipeline spill can, of course, occur anywhere along the pipeline, and a tanker spill anywhere along the tanker route. The above analysis would seem to indicate that from the point of view of Long Island, assuming a find on Nantucket Shoals or eastward, the routing of the transport system is more critical than the location of the find. It is possible that such transport systems could cross relatively high probability contours. Unfortunately, we do not have sufficient data to estimate where along the route pipeline or tanker spills are likely to occur. What little data we do have seems to indicate, for both modes, that spills tend to occur at either end of the link rather than in the middle.

For those situations in which there is a substantial probability of at least one spill reaching shore over the life of a find, then the number of such spills, m, becomes of interest. Consider a two billion barrel find located on a .05 contour landed by pipeline.* According to Table 2, the estimate of the probability that at least one spill reaches shore from such a find is .437. The probability density of the number of such spills is given by

$$q(m) = \sum_{k=0}^{m} \left[\sum_{n=k}^{m} p_1(n) \binom{n}{k} s^k (1-s)^{n-k} \right] \left[\sum_{n=m-k}^{m} p_2(n) \binom{n}{m-k} s^{m-k} (1-s)^{n-m+k} \right]$$

where $p_1(n)$ is the density of the number of pipeline spills and $p_2(n)$ is the density of the number of platform spills. Applying the relevant densities for the two billion barrel find and assuming that we are on the .05 contour (s = .05), the program's results are

TWO BILLION BARREL FIND, LANDED BY PIPELINE, .05 CONTOUR

Number of Spills Larger than 1000 bbl Which Eventually Reach Long Island	Probability of m
m	q(m)
0	.617
1	.294
2	.075
3	.013
4	.001
5	.0002
6	.00003
.	.
.	.
.	.

In this case, the probability that there will be at least one spill reaching shore is about .38. This .38 is made up of a .29 probability that exactly one spill will reach shore, a .08 probability that exactly two spills reach shore, a probability of about .01 that exactly three spills reach shore, and the probabilities of still higher numbers of spills fall of rapidly.

The point is that for the cases toward the upper left of Tables 1 and 2, if a spill reaches shore, it is almost certain there will only be one such spill. For the cases in the bottom left-hand corner of Tables 1 and 2, it is quite likely that there will be more than one such spill. For the intermediate cases, as we illustrated above, even if a spill does reach shore, it is likely that there will only be one such spill, but multiple landings are not impossible. Once again, these computations do not account for weathering.

2. TREATMENT OF SEASONAL VARIATIONS IN LANDING PROBABILITIES

All the results of Section 1 were predicated on the assumption that the probability of an individual spill reaching shore, s, is constant over the life of the find. Actually, Stewart has shown, as is obvious from Figures 1 and 2, that the probability that an individual spills will reach Long Island from a given release point is sharply seasonally dependent. Consider, for example, a hypothetical find located south of Nantucket at 40°40'N and 70°00'W. According to Stewart, the probability that an individual spill will reach Long Island from this point in the summer is .05, while in the winter it is about .01. The spring and autumn probabilities fall between these two numbers.

As a first approximation to this problem of seasonally varying, landing probabilities, assume that we have a find at this location. Assume further that for six months of the year the individual landing probability is .05 and for the other six months it is .01. Under these assumptions, we desire the probability density of the number of spills which will reach Long Island over the field's life as a function of the size of the find. To this end, M.I.T. undertook the following three step analysis:

1) The negative binomial densities of Devanney et al [1974] were recomputed for the half production life of three hypothetical find sizes: 125 MM barrels produced, 500 MM barrels, and 2,000 MM barrels produced. The assumption here is that half the oil

will be produced in the six months 'summer' and half in the 'winter'. This was done for platform spills alone, both platform and pipeline spills combined, and both platform and tanker spills combined. This computation resulted in the following nine probability densities.

PROBABILITY OF n PLATFORM SPILLS OVER 1,000 BBLS IN <u>HALF</u> LIFE

n	250 MM BBL FIND	500 MM BBL FIND	2000 MM BBL FIND
0	.8675	.5738	.1304
1	.1223	.3091	.2378
2	.0096	.0925	.2407
3	.0005	.0036	.1788
4		.0006	.1086
5			.0572
6			.0270
7			.0117

PROB. OF n PLATFORM & PIPELINE SPILLS, 1000+BBLS in <u>HALF</u> LIFE

n	250 MM BBL FIND	500 MM BBL FIND	2000 MM BBL FIND
0	.7344	.3142	.0147
1	.2246	.3516	.0548
2	.0364	.2083	.1086
3	.0041	.0865	.1513
4	.0004	.0286	.1663
5		.0079	.1535
6		.0019	.1238
7		.0004	.0843
8			.0589
9			.0360
10			.0206
11			.0111

PROB. OF n PLATFORM & TANKER SPILLS, 1000+ BBLS IN HALF LIFE

n	250 MM BBL FIND	500 MM BBL FIND	2000 MM BBL FIND
0	.6668	.1995	.0018
1	.2697	.3192	.0116
2	.0550	.2577	.0345
3	.0075	.1399	.0718
4	.0008	.0575	.1130
5		.0191	.1436
6		.0053	.1535
7		.0014	.1418
8		.0003	.1156
9			.0845
10			.0561
11			.0341
12			.0192
13			.0101
14			.0049

2) Next the probability density of the number of spills reaching Long Island in 'summer' and the density of the number of spills reaching Long Island in the 'winter' was computed using

$$\text{Prob}\begin{pmatrix}\text{k spills reaching}\\ \text{shore in season i}\end{pmatrix} = \sum_{n=k}^{\infty} \text{Pr}\begin{pmatrix}\text{n spills occur}\\ \text{ing in half life}\end{pmatrix} \cdot \frac{n!}{k!(n-k)!} \cdot s_i^k (1-s_i)^{n-k}$$

where s_i was taken to be .05 for the summer six months and set equal to .01 for the winter six months. At this point, we are making the erroneus assumption that any pipeline and tanker spills occur in the immediate vicinity of the find.

3) Finally, the probability density of the number of spills reaching Long Island in the 'summer' was convolved with the density of the number of spills reaching Long Island in the 'winter' to obtain the density of the total number of spills reaching Long Island from a find at 40°40'N and 70°00'W

for the nine different situations under analysis.

The results are shown on pages 19 through 21. These tables are taken directly from the computer output. The probabilities are in scientific notation. The number in front of the E is to be multiplied by 10 raised to the power following the E. That is, the number following the E is the exponent. For the negative exponents in these tables, the numbers can be read by simply moving the decimal point to the left m places where m is the exponent.

The above analysis is meant to be exemplary only, to outline the steps which must be undertaken in order to estimate the probability of a spill reaching shore from a given site under seasonally varying landing probabilities. An analysis of an actual find would require considerably more detail both with respect to number of 'seasons' (four instead of two) and especially the location of pipeline and tanker spills.

PLATFORM ONLY, SMALL FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.9284399E-01	9.9854314E-01	9.9130759E-01
1	7.1005598E-03	1.4209598E-03	8.5000473E-03
2	2.7974237E-05	1.1215725E-06	3.0994288E-05
3	6.8795657E-08	5.5036486E-10	1.1703952E-07
4	0.0000000E+00	0.0000000E+00	1.3349395E-10
5	0.0000000E+00	0.0000000E+00	9.2500280E-14
6	0.0000000E+00	0.0000000E+00	3.7862794E-17

PLATFORM ONLY, MEDIUM FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.7173727E-01	9.9420398E-01	9.6610504E-01
1	2.7730349E-02	5.8791855E-03	3.3996783E-02
2	4.3737533E-04	1.7972357E-05	6.1003258E-04
3	4.9935405E-06	4.0231667E-08	7.9953834E-06
4	3.9612449E-08	6.4545327E-11	7.6342897E-08
5	1.7724540E-10	5.6719500E-14	5.0024908E-10
6	0.0000000E+00	0.0000000E+00	1.9477701E-12
7	0.0000000E+00	0.0000000E+00	5.1234414E-15

PLATFORM ONLY, LARGE FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	8.3261436E-01	9.7739589E-01	8.7243760E-01
1	1.6075519E-01	2.2282393E-02	1.1834818E-01
2	6.3129589E-03	2.8205296E-04	8.6667016E-03
3	2.8060779E-04	2.8119105E-06	4.5447660E-04
4	1.9906520E-05	1.9643217E-08	1.9070600E-05
5	3.4388046E-07	1.2558700E-10	6.7710888E-07
6	9.4883088E-09	6.3114869E-13	2.0858625E-08
7	2.2515749E-10	3.2342068E-15	5.6086713E-10
8	4.5322857E-12	1.2463670E-17	1.3058389E-11
9	6.7227385E-14	3.7622740E-20	2.5891903E-13
10	7.5737747E-16	8.3589077E-23	4.2892088E-15
11	5.4045117E-18	1.1628099E-25	5.8451600E-17
12	1.9128529E-20	7.8349839E-29	6.5185989E-19
13	0.0000000E+00	0.0000000E+00	6.0121052E-21
14	0.0000000E+00	0.0000000E+00	4.6935230E-23

PLATFORM AND PIPELINE, SMALL FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.8453134E-01	9.9686116E-01	9.8144192E-01
1	1.5311409E-02	3.1027109E-03	1.8318061E-02
2	1.2549879E-04	5.0870367E-06	1.7762995E-04
3	5.9507337E-07	5.6202225E-09	1.1657903E-06
4	2.3208120E-09	3.7277958E-12	5.2072515E-09
5	0.0000000E+00	0.0000000E+00	1.1527907E-11
6	0.0000000E+00	0.0000000E+00	1.6226139E-14
7	0.0000000E+00	0.0000000E+00	1.5685144E-17
8	0.0000000E+00	0.0000000E+00	8.6850636E-21

PLATFORM AND PIPELINE, MEDIUM FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.4190955E-01	9.8800689E-01	9.3060422E-01
1	5.6190837E-02	1.1820089E-02	6.6650271E-02
2	1.7703718E-03	7.4675700E-05	2.4842409E-03
3	3.8906379E-05	3.2837318E-07	6.3878164E-05
4	6.5198844E-07	1.0975099E-09	1.2557794E-06
5	8.3099216E-09	2.7722095E-12	1.9467997E-08
6	7.2664347E-11	4.7660937E-15	2.3358426E-10
7	3.2227346E-13	4.1250926E-18	2.0598323E-12
8	0.0000000E+00	0.0000000E+00	1.2796495E-14
9	0.0000000E+00	0.0000000E+00	5.9047395E-17
10	0.0000000E+00	0.0000000E+00	2.1188945E-19
11	0.0000000E+00	0.0000000E+00	5.9743362E-22
12	0.0000000E+00	0.0000000E+00	1.2740064E-24
13	0.0000000E+00	0.0000000E+00	1.8357036E-27
14	0.0000000E+00	0.0000000E+00	1.3294078E-30

PLATFORM AND PIPELINE, LARGE FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	7.8825200E-01	9.5321488E-01	7.5137353E-01
1	1.8619609E-01	4.5535218E-02	2.1337807E-01
2	2.3277540E-02	1.1510400E-03	3.1574283E-02
3	2.0459108E-03	2.0446896E-05	3.2405765E-03
4	1.4160569E-04	2.8575437E-07	2.5896728E-04
5	8.1838116E-06	3.3282739E-09	1.7135681E-05
6	4.0775529E-07	3.3317557E-11	9.7345310E-07
7	1.7783449E-08	2.9067059E-13	4.8592493E-08
8	0.0000000E+00	0.0000000E+00	1.4945525E-09
9	0.0000000E+00	0.0000000E+00	3.1691580E-11
10	0.0000000E+00	0.0000000E+00	5.1268473E-13
11	0.0000000E+00	0.0000000E+00	6.7520415E-15
12	0.0000000E+00	0.0000000E+00	7.5152389E-17
13	0.0000000E+00	0.0000000E+00	7.1192352E-19
14	0.0000000E+00	0.0000000E+00	5.1691227E-21

PLATFORM AND TANKER, SMALL FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.7985327E-01	9.9588156E-01	9.7581780E-01
1	1.9872777E-02	4.0307346E-03	2.3749273E-02
2	2.0210069E-04	8.2116658E-06	2.8960407E-04
3	1.3179924E-06	1.1669627E-08	2.3926780E-06
4	6.9996478E-09	7.9556450E-12	1.2093153E-08
5	0.0000000E+00	0.0000000E+00	3.2969114E-11
6	0.0000000E+00	0.0000000E+00	5.5965570E-14
7	0.0000000E+00	0.0000000E+00	6.2737772E-17
8	0.0000000E+00	0.0000000E+00	3.3568459E-20

PLATFORM AND TANKER, MEDIUM FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	9.2291099E-01	9.8383546E-01	9.0799311E-01
1	7.4700359E-02	1.5969817E-02	8.3305593E-02
2	3.0539128E-03	1.3067099E-04	4.3242350E-03
3	8.3843208E-05	7.1612567E-07	1.4177468E-04
4	1.7157908E-06	2.9241389E-09	3.4829609E-06
5	2.7172149E-08	9.2055235E-12	6.7596596E-08
6	3.2481540E-10	2.1742729E-14	1.0673908E-09
7	2.6298139E-12	3.4524428E-17	1.2227945E-11
8	0.0000000E+00	0.0000000E+00	1.0074224E-13
9	0.0000000E+00	0.0000000E+00	6.7320653E-16
10	0.0000000E+00	0.0000000E+00	3.1226995E-18
11	0.0000000E+00	0.0000000E+00	1.1327146E-20
12	0.0000000E+00	0.0000000E+00	3.2200078E-23
13	0.0000000E+00	0.0000000E+00	6.8371610E-26
14	0.0000000E+00	0.0000000E+00	9.0758257E-29

PLATFORM AND TANKER, LARGE FIELD

K	PROB OF K SUMMER SPILLS ASHORE	PROB OF K WINTER SPILLS ASHORE	PROB OF K SPILLS ASHORE
0	7.2500208E-01	9.3704897E-01	6.7748833E-01
1	2.3408997E-01	6.0320647E-02	2.6332718E-01
2	3.8235669E-02	1.9015099E-03	5.1509809E-02
3	4.2004436E-03	4.3339347E-05	6.7596659E-03
4	3.4875749E-04	7.2010638E-07	6.6922040E-04
5	2.3508018E-05	9.7517017E-09	5.3272292E-05
6	1.3021630E-06	1.0885859E-10	3.5467765E-06
7	6.2212166E-08	1.0367896E-12	2.0266452E-07
8	0.0000000E+00	0.0000000E+00	7.6935351E-09
9	0.0000000E+00	0.0000000E+00	2.0137446E-10
10	0.0000000E+00	0.0000000E+00	3.9463736E-12
11	0.0000000E+00	0.0000000E+00	6.0956502E-14
12	0.0000000E+00	0.0000000E+00	7.7259209E-16
13	0.0000000E+00	0.0000000E+00	8.1223975E-18
14	0.0000000E+00	0.0000000E+00	6.4500908E-20

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